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REMARKS FOR RECORD

16 September 1954

SUBJECT: Meeting of Upper Atmosphere Rocket Research Panel

1. At the invitation of Air Force Scientific Advisory Board, I attended a meeting of the Upper Atmosphere Rocket Research Panel on 8 September at the Naval Research Laboratory, Anacostia. The two agenda items of primary concern were: 1) High Altitude and Satellite Vehicles, 2) International Geophysical Year, and the logistics therefor.

2. This panel was formed in 1948 by representatives of various organizations which were concerned with upper atmosphere research through rockets. It is chaired by Dr. James A. Van Allen who is Chairman of the Department of Physics, State University of Iowa. The panel has representation from Aberdeen Proving Grounds, University of Michigan, Naval Research Laboratory, General Electric Company, Naval Research Laboratory, Air Force Cambridge Research Center, California Institute of Technology, and Harvard Observatory. It has no official connection with any Department of Defense organization but is informally supported by the Office of Naval Research. In connection with the forthcoming International Geophysical Year, it has been assigned the function of monitoring the United States program for upper atmosphere research through the use of high altitude rockets.

3. At the 8 September meeting, there were in addition to the panel itself, representatives from the Chief of Ordnance, United States Navy, the Redstone Arsenal, the Ford Corporation, the Office of Naval Research, Aerophysics Development Corporation, Air Force AFSC, NASA, National Science Foundation, etc.

4. Dr. J. A. Van Allen opened the discussion of the first agenda item - High Altitude and Satellite Vehicles - by a discussion of past upper atmosphere research with rockets. He cited the extensive use of V-2s which could carry 2,000 pounds payload to a 100 miles altitude but the majority of which has now been exhausted. He mentioned the W-2-Corporal which was not used as a single site vehicle, primarily because it could carry only 24 pounds to an altitude of 100 miles. The W-2-Corporal was however, used in the second stage in combination with the V-2 and achieved an altitude of 210 miles. Since exhaustion of the V-2 is over, the other rockets have been enveloped and used as civilian research instruments. These are the Viking which in its present form can carry 400 pounds payload to 135 miles.

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altitude and in its forthcoming modification will carry 500 pounds to 125 miles altitude. The second rocket is the Aerobee which can carry 150 pounds payload to 65 miles altitude. In addition to these two, there is also the ~~BL-1~~ which is a system of launching a research rocket from a "piggyback" balloon. The launch is made at a balloon altitude of approximately 100,000 feet and the rocket carries 30 pounds of instrumentation to an altitude of 60 miles. Dr. Van Allen concluded his presentation by stating that, from here on, civilian upper atmosphere rocket research will probably be dormant, due to lack of civilian funds, until the military rockets being developed now by the Department of Defense. He then introduced Mr. Fred Whipple of the Harvard Observatory for a discussion of Earth Satellite Vehicles (ESV).

5. Dr. Whipple stated that the interests of civilian research and of the Department of Defense in ESV are synonymous. He pointed out the main scientific gains which could be made through the ESV which have application both to civilian science and to defense. These include aeronomy, astrometry, solar-terrestrial relations, far ultraviolet and X-ray research, etc. He described the ESV sequence as being in three phases as follows:

- (1) The placing in orbit of an observable object (uninstrumented) which could be seen either optically or by radio.
- (2) The placing in orbit of an instrumented vehicle, "an unruined physical laboratory". This phase will be a progressive development starting with a very small vehicle similar to the dinner plate, which will carry telemetering equipment. Larger capacity will be achieved as bigger and more reliable power plants are developed. These latter will probably be nuclear or solar energy plants. Instrumentation starting with simple telemetering will progress through more complicated stages until television and finally a telescope is included. The last stage in this phase will be a remote controlled vehicle.
- (3) The final phase of ESV will be the putting in orbit of a manned satellite vehicle.

6. Dr. Whipple emphasized that the placing of a slug in orbit was in fact the first step in the process. He stated that such a vehicle even without instrumentation could produce useful scientific results such as air density data and relative positions on the earth. The main problem in connection with a slug (phase 1) is that of observation from the earth, which will require much study. This problem will be simplified if the ESV is on either an equatorial or a polar orbit. In regard to

the unmanned instrumented vehicle (Phase 2), he said that the main problems will be development of small reliable power plants; television, the technical development of which is already well along; orientation of the vehicle itself and of the instrumentation carried; and constant reduction of weight of the equipment to be carried. He stated that the altitude at which the vehicle should orbit will depend upon the purpose envisaged. Theoretically, an altitude of 1,000 miles at a speed of 5 miles per second would be ideal. This would provide a 2-hour orbit.

7. Mr. George Brown, Director of the Air Branch, ORNL, made the next presentation, concerning high altitude vehicle projects with which ORNL is concerned. ORNL has three main projects in this field, the first of which is the development of a manned conventional aircraft to operate at a maximum altitude of 300 miles. Two designs are presently under consideration - the Douglas 553 and the Vought 551. The former is designed to have an altitude of 700,000 feet. (Note: this field of study is covered in Report R-307-1246(31), "Low Altitude and High Speed Study" by Douglas Aircraft Corporation, CircumILL). The second ORNL project is development of a manned high altitude balloon to operate at 100 to 200,000 feet. The system would be based on the "Skyhook" polyethylene balloon carrying a gondola equipped to sustain one or two men. The third project is for manned space flight and the study of this is being conducted at the Aero Jet Laboratory. The first phase of this latter project is called SLB3, the purpose of which is to place an LV in orbit at an altitude of 200 miles in order to acquire meteorological and atmospheric data at that level as the first step toward higher altitude work. Project SLB3 has been tentatively approved by the Navy and ORNL is going ahead with it in cooperation with the Army. It is now also being coordinated with the Air Force at a very high level. The project calls for the use of the Army Redstone missile (see para. 8 below) as the first stage with the Loki cluster (see para. 9 below) providing the second and third stages. Under Aero Jet leadership, four subsidiary studies are planned to be undertaken as follows:

- (1) A Visibility Study to determine the size and weight of the vehicle required at an altitude of 200 miles. It is hoped that Mr. Fred Whipple will be the leader of this.
- (2) An Orbital Study to determine the power required, the guidance system, etc. It is hoped that Mr. S. Fred Singer of the University of Maryland will lead this.
- (3) A Burn-Trajectory Study to determine the final design and the staging requirements.

(b) A launching study to determine where and how the vehicle should be launched, the logistics requirements, and the range risks involved.

Following the completion of these four studies, construction of the actual vehicle will be commenced. It is considered that successful completion of Project 1111 will lead into the launching of a vehicle similar to the latter [REDACTED] i.e., an instrumented vehicle using a polar orbit at an altitude of 200 miles. It is expected that [REDACTED] would remain aloft for ten days while [REDACTED] could probably sustain its orbit for about one month. It is also never emphasized that if adequate funding is available for Project 1111, [REDACTED] might well be used during the International Geophysical Year. It laid great stress on the necessity for the United States being the first in launching an I.G.Y. satellite that Project 1111 was absolutely essential to achieve this aim.

On 10 May 1958 Mr. Walter G. Moore then gave a briefing on the Redstone missile. The Redstone model 1A-11, as a tactical weapon, has a range of 1/2 miles with a trajectory apex of 63 miles. If used as a research tool, it has a vertical range of 110 miles with a weight of about 10 pounds. The modified 1A-11 which is now under development will have a vertical range of 270 miles with an aperture of total allowable of 500 pounds. Redstone research is now feasible by the construction of these missiles as research instruments. They will cost 70,000 to 100,000 per missile if more than five or ten are produced. They have a speed of approximately 1,200 ft/sec.

On 11 May 1958 Mr. John W. Thompson gave a presentation describing the proposed new vehicle which they are developing as an air base project. The vehicle comprises two clusters of solid rockets; the first cluster of seven acting as the first stage booster, the second cluster of four constituting the second stage. It has a range of 100-120 and a payload of 10 pounds. When launched vertically from an altitude of 10,000 feet, it is designed to reach an altitude of 100 miles. It is planned to use either a flakship IRM system or a folding radar reflector for tracking purposes. At two-thirds range, it is expected to get an altitude of 20 miles. With post-boost I rocket, the second stage descends 100 miles. No missile has yet to be flown vertically as a research instrument. The speakers indicated that the second stage cluster could be adapted to carry 12 pounds of supplemental tracking equipment.

On 12 May 1958 Mr. Moore commented briefly on a design which they are developing which consists of the Redstone booster as the first stage and a solid rocket as the second stage. It is estimated that the vehicle could attain an altitude of 100,000 feet. It would be very low cost, in the range of .7,000 to .3,000.

11. Mr. Hollister of the National Defense Foundation gave a brief account of contribution of his funds for upper atmosphere rocket research. One million, three-hundred thousand dollars is presently available and about 70% of this will be transferred immediately to GOM for procurement and accounting purposes. The balance of the rocket project funds - \$400,000 - will become available next year.

12. Following adjournment of the panel meeting, I spent a couple of hours with Mr. Van Allen, who had served under me for a time during World War II. Van Allen was one of the key figures in the development of the V-2 fuse under Admiral Parsons and was one of the officials inclined to initiate the fuse to the Pacific Fleet. In our conversation, I mentioned the difficulty that apparently would be encountered in the JCS program, of securing scientific equipment which would stand the high G's encountered in most of a missile rockets, particularly with solid propellant. I mentioned specifically the 160 G's experienced in stage two of the Loki cluster vehicle. Mr. Van Allen said that there should be no such difficulty. He pointed out that the V-2 fuse contained five miniature resistors, a battery and a thermocouple, and that this instrument, with practically no failure, withstanded 20,000 G's when fired from the naval 5-inch semi-armored gun. He pointed out also that in the 1940's a system which has been in use for some time, the German rocket carried 30 pounds of instrumentation for scientific research and telemetry, and with loads of 30 G's. He said that he saw no difficulty whatever in securing instrumentation for high altitude rockets which could easily withstand 1,000 G's. In regard to the V-2's present capability, he agreed thoroughly with Lt. Col. Rader, that the alternative first step was to launch a satellite. He felt that if the level government priority could be established, with guidance and control by an outside high level scientific group, it would almost certainly be possible to put a ship in orbit by the time of the IY and possibly even put up an instrumented vehicle.

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